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THE AERODYNAMIC TESTS OF THREE EDO FLOATS FOR THE SB2U-3, OS2U-2, AND XSB2C-2 SEAPLANES - NACA MODELS 106-K, 107-K, AND 125-AH

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NACA

WASHINGTON

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

MEMORANDUM REPORT

for the

Bureau of Aeronautics, Navy Department

THE AERODYNAMIC TESTS OF THREE EDO FLOATS

FOR THE SB2U-3, OS2U-2, AND XSB2C-2

SEAPLANES - NACA MODELS

106-K, 107-K, AND 125-AH

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INTRODUCTION

At the request of the Bureau of Aeronautics, aerodynamic tests have been made on $\frac{1}{4}$-scale models of the Edo seaplane floats for the SB2U-3 (model 106-K), OS2U-2 (model 107-K), and XSB2C-2 (model 125-AH) seaplanes.

APPARATUS AND TESTS

Models.- The models used in these tests were originally constructed for tests in the NACA tank. They were made of wood and had a smooth lacquer finish. The basic dimensions and the tables of offsets of the models are shown in tables I to III and figures 1 to 3, inclusive.

Models 106-K and 107-K were chosen as the modifications of these two basic float designs to be tested as it was concluded from tank tests that this modification gave better hydrodynamic characteristics. These modifications (K) have shallow flutes on the forebody and a flared bottom on the afterbody.

Model 125-AH is the basic design and has flutes on both the forebody and afterbody.

Wind tunnel.- The models were mounted on the standard force-tests tripod in the NACA 7- by 10-foot closed throat wind tunnel

which is described in detail in reference 1. A typical float installation in the 7- by 10-foot tunnel is shown in figure 4.

Tests.- Models 106-K and 107-K were tested at a dynamic pressure of 16.37 pounds per square foot corresponding to an airspeed of about 80 miles per hour at standard sea-level conditions. To obtain the same effective Reynolds number of approximately 1,500,000 (based on volume$^{1/3}$ and a tunnel turbulence factor of 1.6) that is needed for exact comparability of models, model 125-AH was tested at a dynamic pressure of 10.8 pounds per square foot which corresponds to an airspeed of about 65 miles per hour.

For a base line in determining angle of pitch, the deck line, as shown in a side-view drawing, was used. For the three floats it was found that this line was straight throughout its length except for a small portion near the nose.

As part of the mounting tripod projects into the air stream and as the strut affects the air flow, tare tests were first made on models 106-K and 125-AH. The floats were mounted in an upright position with a dummy strut alternately on and off to get the resulting net tare. The tare values were subtracted from the regular test readings to obtain the net forces and moments on the floats. The tare values obtained in testing 106-K were applied to the 107-K test results because of the similarity of the two floats.

For the regular tests the models were mounted inverted on the tripod. Three tests were made on each float; namely, a pitch test at zero yaw and two yaw tests, one at zero and the other at 10° angle of attack. The pitch-angle range from -10° to 16° was taken in 2° increments and the yaw-angle range from -5° to 20°, in 5° increments.

RESULTS AND DISCUSSION

The results are given by standard coefficients referred to the wind axes and are defined as follows:

C_L lift coefficient $\frac{L}{qV^{2/3}}$

C_D drag coefficient $\frac{D}{qV^{2/3}}$

C_Y lateral-force coefficient $\frac{Y}{qV^{2/3}}$

C_m pitching-moment coefficient $\frac{M}{qV}$

C_n yawing-moment coefficient $\frac{N}{qV}$

where

L force along Z axis; positive when directed upward

D force along X axis; positive when directed backward

Y force along Y axis; positive when directed to right

M pitching moment about Y axis, positive when it tends to depress afterbody (See figs. 1, 2, and 3.)

N yawing moment about Z axis; positive when clockwise, as viewed from above (See figs. 1, 2, and 3.)

V volume of the float (cu ft)

q dynamic pressure (slugs/cu ft)

and

α angle of attack, degrees; positive when forebody is raised

ψ angle of yaw, degrees; positive when rotated clockwise, as viewed from above

Coefficients are based on volume rather than area as the volume of a float is a more important variable in design, being largely determined by the weight of the airplane. This procedure was followed in previous tests as shown in reference 2.

The test results are plotted in figures 5 to 7, inclusive.

Even though model 125-AH has fuller ends, it shows a lower drag coefficient than either models 106-K or 107-K within the usual operating range of about -2° to 7° angle of attack. This is probably due to the smaller amount of curvature of the midship section. By selecting the deck line as a reference for measuring angle of attack, minimum drag occurs for all floats at zero angle of attack.

The pitching- and yawing-moment coefficient curves cannot be exactly compared as the position about which the moments are given

is not at the same location for all three models. The floats follow the rule for most streamline bodies in that they are unstable in both pitch and yaw about any point on the body itself.

The minimum drag coefficients of the three floats tested are comparable to those of the floats in reference 2.

Langley Memorial Aeronautical Laboratory,
National Advisory Committee for Aeronautics,
Langley Field, Va., March 27, 1942.

REFERENCES

1. Harris, T. A.: The 7 by 10 Foot Wind Tunnel of the National Advisory Committee for Aeronautics. NACA Rep. No. 412, 1931.

2. Parkinson, J. B., and House, R. O.: Hydrodynamic and Aerodynamic Tests of Models of Floats for Single-Float Seaplanes. N.A.C.A. Models 41-D, 41-E, 61-A, 73, and 73-A. NACA TN No. 656, 1938.

TABLE OF OFFSETS - MODEL 106K

[All Offsets in Inches, Full Size]

Station	Half Breadth		Height above datum line			
	Chine	Sister Keelson	Keel	Chine	Sister Keelson	Deck
0	0	-------	31.69	31.69	-------	31.69
1	3.19	-------	28.27	30.11	-------	32.77
3	5.49	-------	25.55	28.72	-------	33.63
8	8.84	-------	21.41	26.51	-------	34.87
16	12.20	-------	17.10	24.14	-------	36.15
29	15.74	-------	12.13	21.22	-------	37.51
44	18.38	-------	8.10	18.71	-------	38.43
59	20.03	10.65	5.15	16.71	11.97	38.92
68	20.57	11.18	3.75	15.69	10.83	39.00
89	21.66	12.02	1.51	14.02	9.16	39.00
112	22.30	12.58	.52	13.40	8.02	39.00
119	22.40	12.68	.46	13.34	7.82	39.00
134	22.50	12.83	.33	13.21	7.49	39.00
146	22.44	12.94	.23	13.11	7.20	39.00
179F	22.09	13.00	-.05	12.83	6.39	39.00
179A	21.42	-------	3.70	16.37	-------	39.00
194	20.42	-------	5.50	17.77	-------	39.00
220	18.78	-------	8.59	19.87	-------	39.00
246	16.53	-------	11.69	21.62	-------	39.00
272	13.47	-------	14.78	22.87	-------	39.00
298	9.35	-------	17.88	23.91	-------	39.00
325F	3.55	-------	21.09	23.41	-------	39.00
325A	3.59	-------	24.20	24.20	-------	39.00
335	6.32	-------	25.75	25.75	-------	39.00

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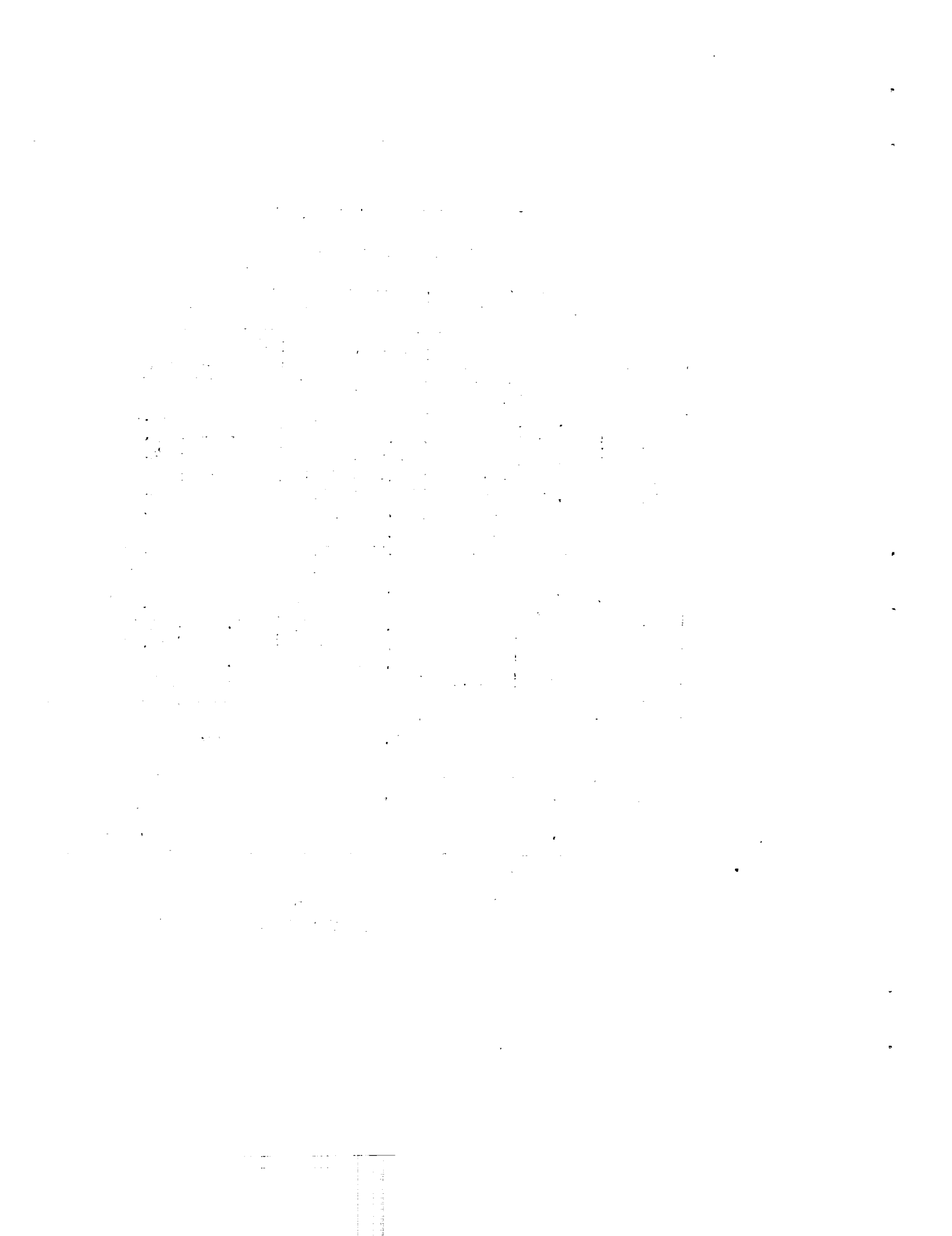

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TABLE OF OFFSETS - MODEL 107K

[All Offsets in Inches, Full Size]

Station	Half Breadth		Height above datum line			
	Chine	Sister Keelson	Keel	Chine	Sister Keelson	Deck
0	0	-------	33.31	33.31	-------	33.31
25	5.29	-------	26.58	29.91	-------	36.10
5.5	7.76	-------	23.30	27.87	-------	37.05
8.5	9.53	-------	20.97	26.22	-------	37.70
14.5	12.13	-------	17.19	23.50	-------	38.61
26.5	15.54	-------	11.90	19.43	-------	39.69
38.5	17.63	-------	8.09	16.67	-------	40.27
55.5	19.60	-------	4.46	13.78	-------	40.67
72.5	21.19	12.15	1.94	12.00	8.65	40.75
104.5	23.09	13.11	0	10.92	6.66	40.75
135	23.75	13.35	0	10.92	6.18	40.75
161	23.43	13.64	0	10.92	5.76	40.75
174F	22.91	-------	0	10.92	5.57	40.75
174A	22.07	-------	4.05	14.98	-------	40.75
187	21.27	-------	5.53	16.02	-------	40.75
212	19.22	-------	8.36	17.84	-------	40.75
237	16.37	-------	11.20	19.27	-------	40.75
262	12.70	-------	14.03	20.30	-------	40.75
287	8.21	-------	16.87	20.92	-------	40.75
311F	3.11	-------	19.59	21.12	-------	40.75
211A	3.09	-------	22.09	22.09	-------	40.75
321	.75	-------	23.58	23.58	-------	40.75

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TABLE OF OFFSETS - MODEL 125-AH

[All Offsets in Inches, Full Size]

Station	Half Breadth		Height above datum line			
	Chine	Sister Keelson	Keel	Chine	Sister Keelson	Deck
0	0	-------	37.30	37.30	-------	37.30
2	7.16	-------	32.05	35.78	-------	38.96
5	10.31	-------	28.87	34.24	-------	40.00
10	13.50	-------	25.11	32.14	-------	41.13
20	17.42	-------	20.00	29.07	-------	42.68
39	21.84	-------	13.32	24.69	-------	44.49
57	24.42	-------	8.95	21.66	-------	45.47
75	26.01	13.94	5.75	19.29	14.18	45.97
111	27.66	15.56	1.72	16.12	10.32	46.00
147	28.00	16.00	.63	15.19	8.82	46.00
177	27.70	16.00	.36	14.92	8.30	46.00
198	27.53	16.00	.18	14.74	7.93	46.00
219F	27.33	16.00	0	14.56	7.57	46.00
219A	26.54	14.57	4.53	18.05	11.16	46.00
243	25.61	13.37	7.51	20.56	13.85	46.00
274	23.99	11.83	11.36	23.58	17.33	46.00
305	21.61	10.28	15.21	26.22	20.81	46.00
336	18.13	8.74	19.05	28.29	24.28	46.00
367	12.96	-------	22.90	29.50	-------	46.00
398F	5.21	-------	26.75	29.40	-------	46.00
398A	5.21	-------	30.90	30.90	-------	46.00
410	1.57	-------	32.95	32.95	-------	46.00

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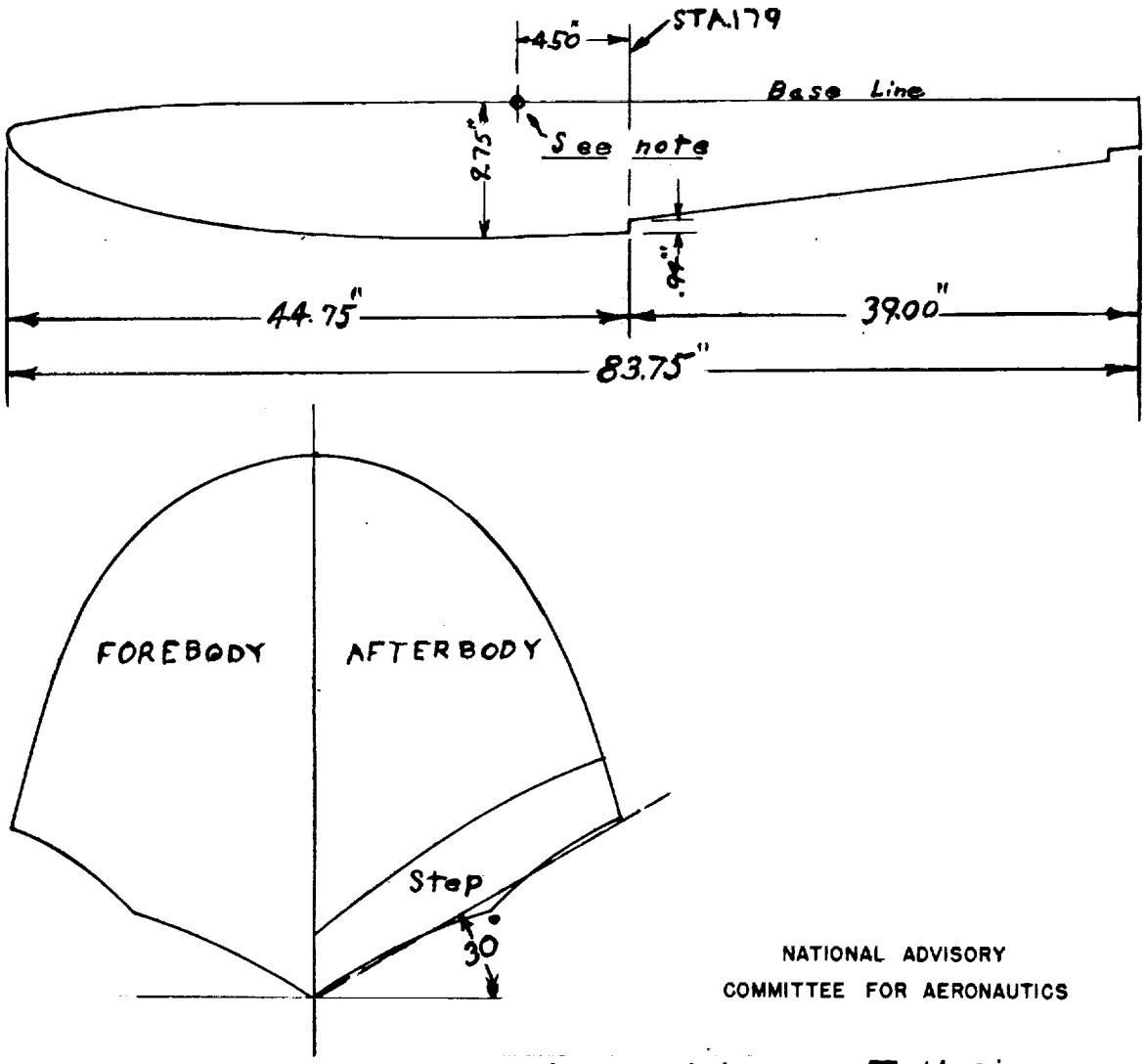

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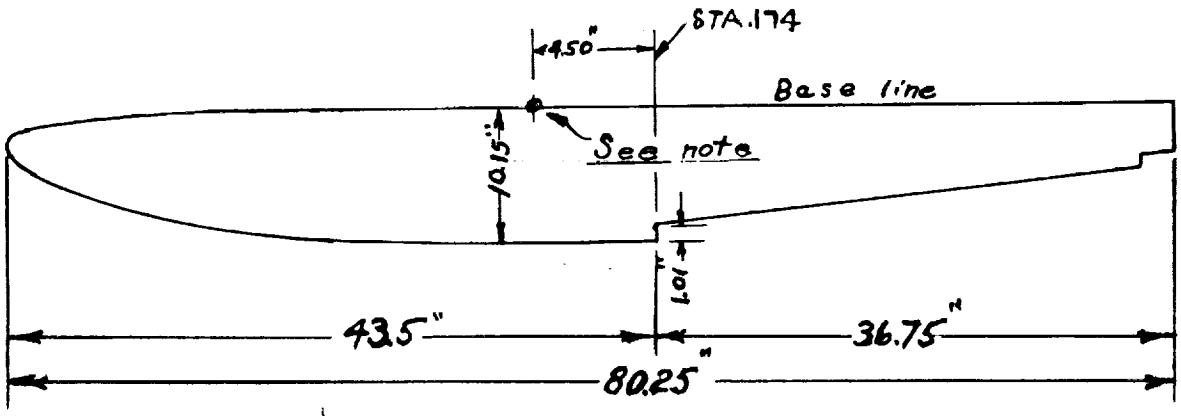
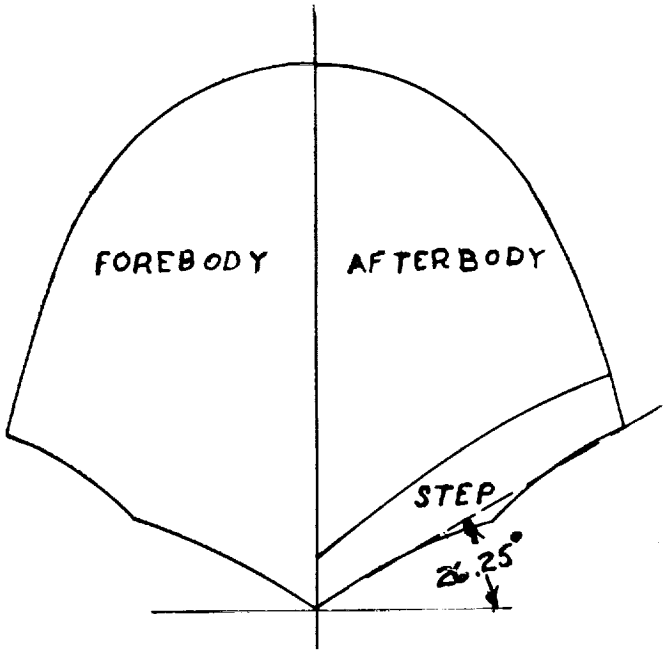
	1/4-size model	Full size
Volume	2.20 cu.ft.	140.62 cu.ft.
Volume$^{2/3}$	1.69 sq.ft.	

Note: Location of position on float to which all moments were transferred.

FIG. 1 - Principal dimensions of model 106-K





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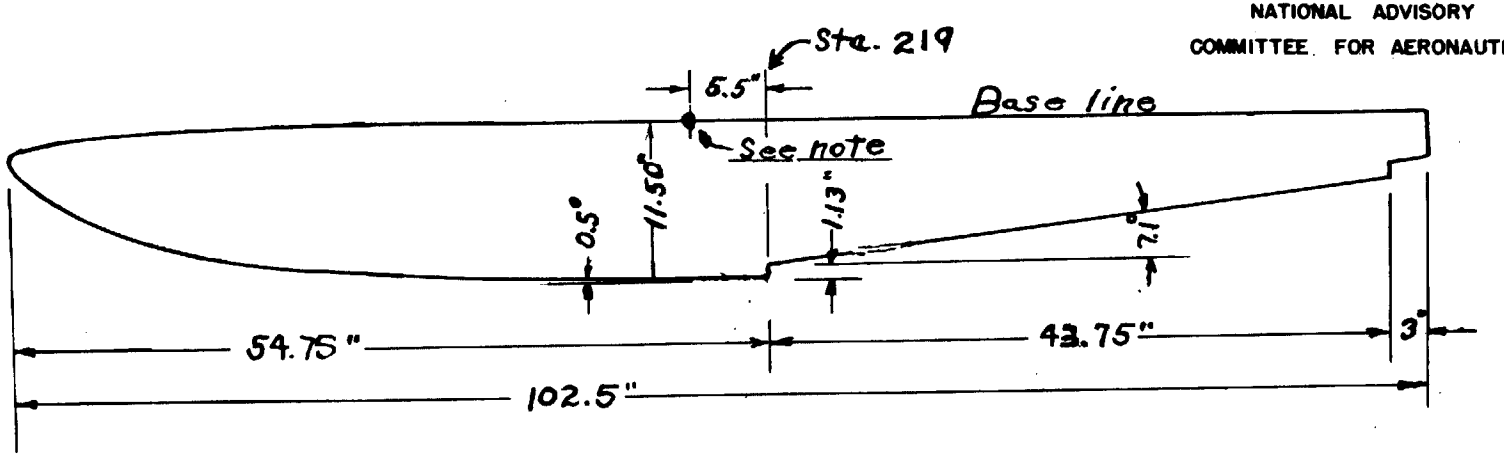
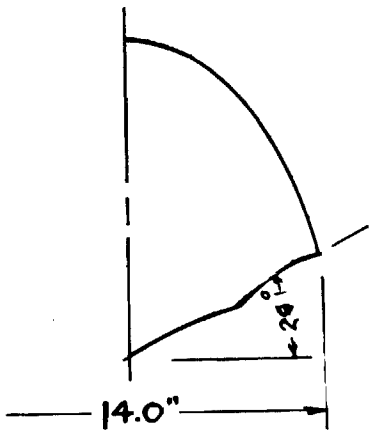
	1/4 - size model	Full size
Volume	2.39 cu. ft.	153.12 cu. ft.
Volume$^{2/3}$	1.79 ft. sq.	

Note: Location of position on float to which all moments were transferred.

FIG. 2.- Principal dimensions of model 107-K





	1/4-size model	Full size
Volume	4.10 cu. ft.	262.50 cu. ft.
Volume$^{2/3}$	2.56 sq. ft.	

Note: Location of position on float to which all moments were transferred.

FIG. 3 - Principal dimensions of basic model, NACA model 125-AH.

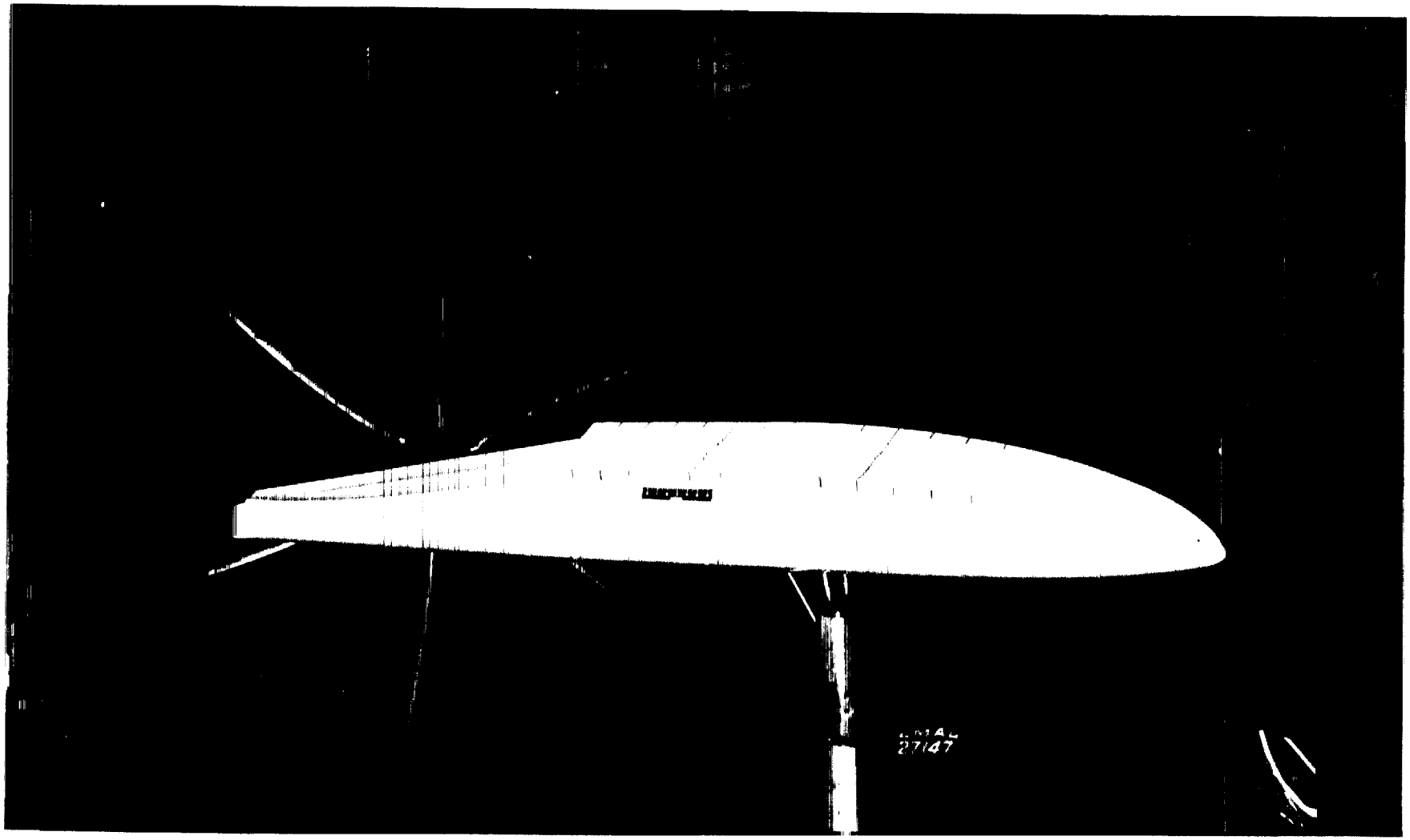


Figure 4.- Model 125-AH mounted in the 7- by 10-foot wind tunnel.

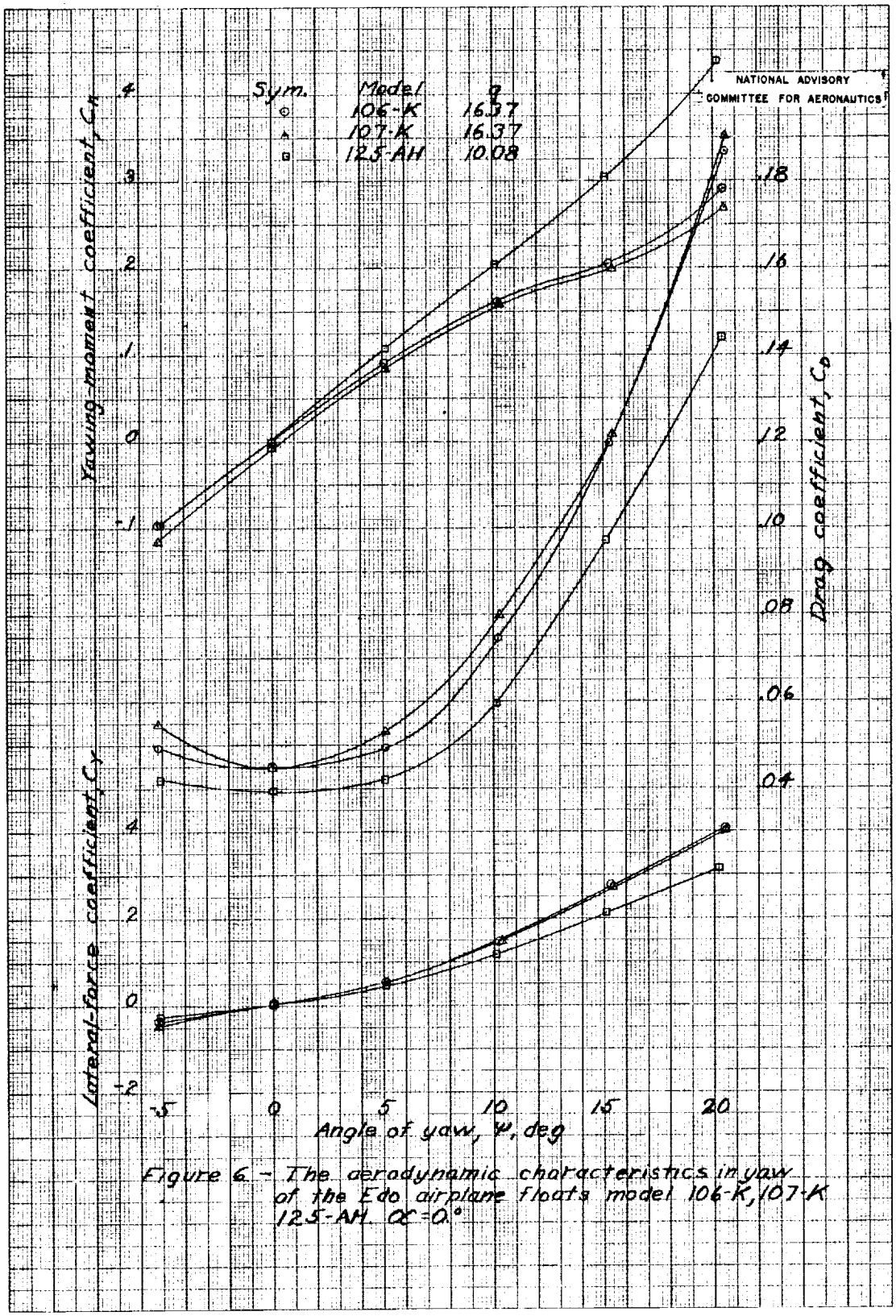


Figure 6 - The aerodynamic characteristics in yaw of the Edo airplane floats model 106-K, 107-K 125-AH. $\alpha = 0.°$

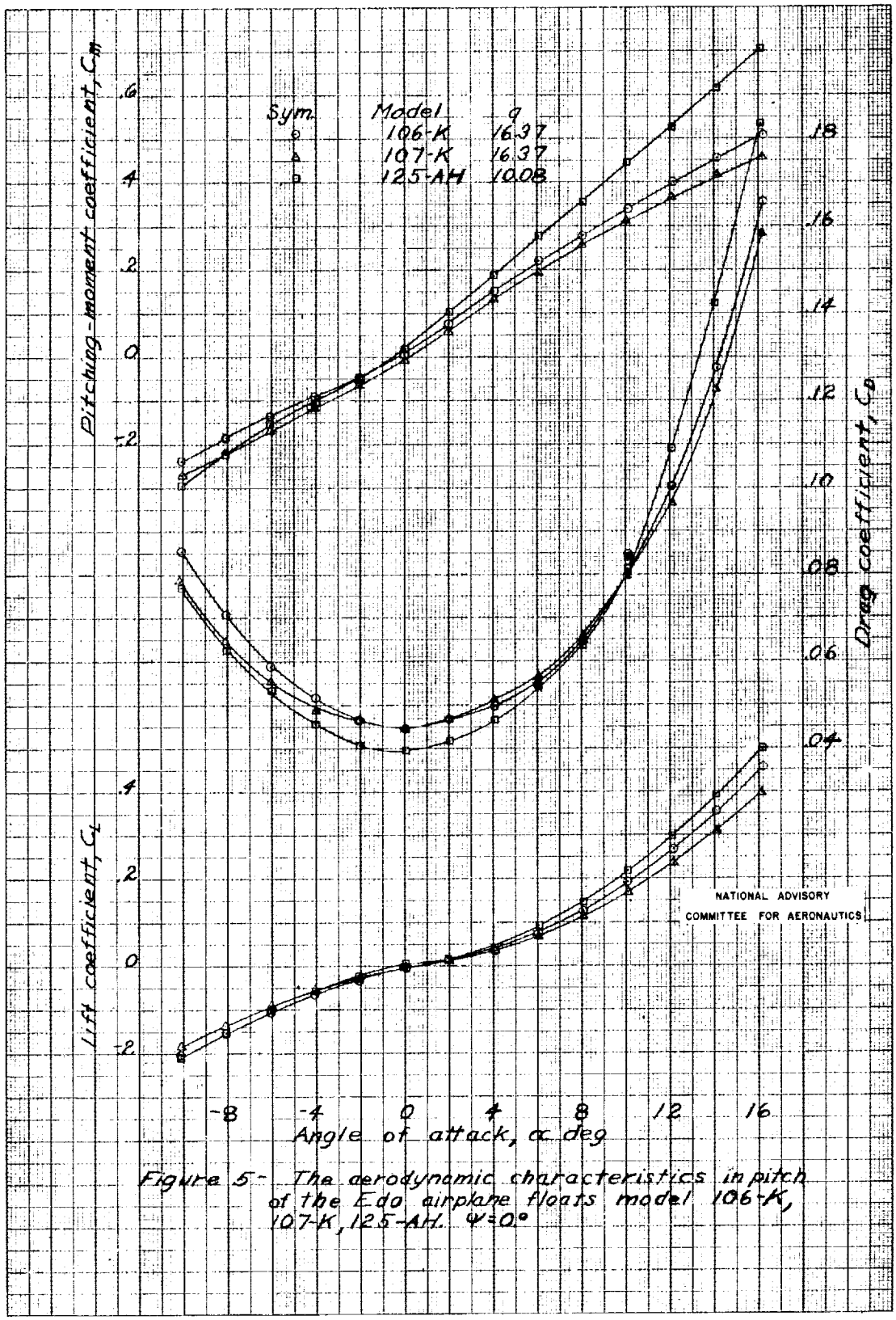


Figure 5- The aerodynamic characteristics in pitch of the Edo airplane floats model 106-K, 107-K, 125-AH. $\Psi = 0°$

Figure 7.- The aerodynamic characteristics in yaw of the Edo airplane floats model 106-K, 107-K, 125-AH. $\alpha = 10.1°$